University of the West of Scotland

Module Descriptor

Session: 2024/25

Title of Module: Advanced Aerodynamics			
Code: ENGG10027	**SCQF Level: 10 (Scottish Credit and Qualifications Framework)**	**Credit Points: 20**	**ECTS: 10 (European Credit Transfer Scheme)**
School:	School of Computing Engineering and Physical Sciences		
Module Co-ordinator:	Dr Noorfazreena Kamaruddin		

Summary of Module

This module is designed to build upon the student's understanding of aerodynamics beyond the principles, and into more specialised fields of aerodynamics.

Outcome 1 is intended to provide the student with an understanding of the physical principles that support the theory of rotary wing aircraft. Students will consider the flow behaviour and performance criteria for rotary wing systems.

Outcome 2 is intended to develop the student's understanding of key concepts in high-speed aerodynamics. Students will consider isentropic flow and analyse flow behaviour in the presence of shockwaves. Isentropic nozzle and diffuser design will be discussed.

Outcome 3 is intended to extend the student's understanding of mathematical modelling of fluid behaviour. Focus will be placed on modelling of the viscous boundary layer using Prandtl's Boundary Layer Equations.

Outcome 4 is intended to develop the student's understanding of concepts relating to aeroelastic phenomena, including analysis of linear translational, torsional, and combined (coupled) vibrations, with and without damping. The method of solution will be based on modelling of engineering systems and matrix methods allied to computerised solutions.

Outcome 5 is intended to provide the student with an understanding of aerodynamic technologies. Key technologies including laminar flow control and drag reduction systems will be considered. The students will then have an opportunity to explore emerging aerodynamic technologies.

By undertaking this module, students will have the opportunity to develop their UWS Graduate Attributes (https://www.uws.ac.uk/current-students/your-graduate-attributes/), including critical thinking, problem solving, effective communication, autonomy, and being knowledgeable and research-minded.

This module has been reviewed and updated, taking cognisance of the University's Curriculum Framework principles. Examples of this are found within the module such as weekly formative tutorial groups scaffolding towards end of module summative assessment, recorded lecture content supporting students to organise their own study time, and student-centred self-directed assessment focussing on critical analysis of real-world practical problems.

Module Delivery Method					
Face-To-Face	**Blended**	**Fully Online**	**HybridC**	**Hybrid 0**	**Work-Based Learning**
☒	☐	☐	☐	☐	☐
See Guidance Note for details.					

Campus(es) for Module Delivery						
The module will **normally** be offered on the following campuses / or by Distance/Online Learning: (Provided viable student numbers permit) (tick as appropriate)						
Paisley:	Ayr:	Dumfries:	Lanarkshire:	London:	Distance/Online Learning:	Other:
☒	☐	☐	☐	☐	☐	

Term(s) for Module Delivery					
(Provided viable student numbers permit).					
Term 1	☒	Term 2	☐	Term 3	☐

Learning Outcomes: (maximum of 5 statements) At the end of this module the student will be able to:	
L1	Examine rotary wing performance and analyse flow behaviour around rotary wings.
L2	Apply knowledge of compressible flow behaviour to perform calculations in high-speed aerodynamics..
L3	Apply mathematical models of viscous fluid behaviour to analyse the boundary layer.
L4	Solve complex problems of multi degree of freedom vibrational engineering systems relevant to aeroelasticity
L5	Examine and assess key technologies in aerodynamics, including new emerging technologies.

Employability Skills and Personal Development Planning (PDP) Skills	
SCQF Headings	During completion of this module, there will be an opportunity to achieve core skills in:
Knowledge and Understanding (K and U)	SCQF Level **10** A broad knowledge and understanding of high-speed aerodynamics, boundary layer flow behaviour, and rotary aerodynamics. Specific and detailed knowledge and understanding of the application, techniques and practices associated with high speed aerodynamics, boundary layer flow behaviour, and key aerodynamic technologies.
Practice: Applied Knowledge and Understanding	SCQF Level **10** Applying knowledge and understanding to analyse and solve complex aerodynamic problems. Select and critically evaluate technical literature and other sources of information to solve complex problems Evaluate the environmental and societal impact of solutions to complex problems (to include the entire life-cycle of a product or process) and minimise adverse impacts.
Generic Cognitive skills	SCQF Level **10** Bringing information together from a variety of sources during problem solving and being able to explain potential problems with methods and strategies. Be able to compare suggested solutions with expected values.
Communication, ICT and Numeracy Skills	SCQF Level **10** Ability to perform, interpret and evaluate complex numerical, geometrical and graphical data and using it to solve problems associated with aerodynamic concepts. Ability to derive and solve complex equations. Using communications skills to prepare and deliver technical reports, including text and illustration.
Autonomy, Accountability and Working with others	SCQF Level **10** Identifying and addressing their own learning needs both during and out with class time.

	Identifying solution routes and strategies using their own initiative and informed judgements.	
Pre-requisites:	Before undertaking this module the student should have undertaken the following:	
	Module Code: ENGG09027	**Module Title:** Aircraft Design and Performance
	Other:	
Co-requisites	**Module Code:**	**Module Title:**

*Indicates that module descriptor is not published.

Learning and Teaching	
The learning and teaching activity for this module include lectures, tutorials and problem-based learning.	
Learning Activities During completion of this module, the learning activities undertaken to achieve the module learning outcomes are stated below:	**Student Learning Hours** (Normally totalling 200 hours): (Note: Learning hours include both contact hours and hours spent on other learning activities)
Lecture/Core Content Delivery	18
Tutorial/Synchronous Support Activity	18
Independent Study	164
	Hours Total 200

****Indicative Resources: (eg. Core text, journals, internet access)**

The following materials form essential underpinning for the module content and ultimately for the learning outcomes:

Course notes and presentations will be provided.

Anderson, J.D. (2006) Fundamentals of Aerodynamics. 4th ed. McGraw-Hill

Barnard, R.H and Philpott, D.R. (2009) Aircraft Flight: A Description of the Physical Principles of Aircraft Flight. 4th ed. Prentice-Hall

Leishman, J.G. (2016) Principles of helicopter aerodynamics, Cambridge Aerospace Series

Bramwell, A.R.S. et al. (2001) Bramwell's helicopter dynamics. 2nd ed. Butterworth-Heinemann

Padfield, G.D. (2007) Helicopter flight dynamics: the theory and application of flying qualities and simulation modelling. Blackwell Publishing

Stepniewski and Keys, C.N. (1984) Rotary Wing Aerodynamics. Dover Publications

Houghton, E.L. (2003) Aerodynamics for Engineering Students. 5th ed. Butterworth-Heinemann

Fillipone, A. (2006) Flight Performance of Fixed and Rotary Wing Aircraft, Elsevier

(**N.B. Although reading lists should include current publications, students are advised (particularly for material marked with an asterisk*) to wait until the start of session for confirmation of the most up-to-date material)

Attendance and Engagement Requirements

In line with the Student Attendance and Engagement Procedure: Students are academically engaged if they are regularly attending and participating in timetabled on-campus and online teaching sessions, asynchronous online learning activities, course-related learning resources, and complete assessments and submit these on time.

Equality and Diversity

The University's Equality, Diversity and Human Rights Procedure can be accessed at the following link: UWS Equality, Diversity and Human Rights Code.

(N.B. Every effort will be made by the University to accommodate any equality and diversity issues brought to the attention of the School)

Supplemental Information

Divisional Programme Board	Engineering and Physical Sciences
Assessment Results (Pass/Fail)	Yes ☐No ☒
School Assessment Board	Engineering
Moderator	Bassam Rakhshani
External Examiner	E Tingas
Accreditation Details	This module is part of the IMechE accredited programmes BEng/Meng (Hons) Aircraft Engineering.

Changes/Version Number	2.15 (was 2.14) Module Coordinator changed to Noorfazreena Kamaruddin from Stephanie Docherty Module Delivery Changed to Face-To-Face from Blended & Face-To-Face

Assessment: (also refer to Assessment Outcomes Grids below)
Formative assessment will be provided during lectures (in the form of class quizzes and example problems), during tutorial sessions, and as part of preparation for written submissions. Summative assessment will be in the form of an unseen closed book formal examination, and a coursework assignment based on investigation of aerodynamic technologies. A minimum overall 40% is required to achieve a pass in this module. Assessment 1 – Unseen Open book examination 65% of the final mark.
Assessment 2- A case study assignment worth 35% of the final mark.
(N.B. (i) **Assessment Outcomes Grids** for the module (one for each component) can be found below which clearly demonstrate how the learning outcomes of the module will be assessed. (ii) An **indicative schedule** listing approximate times within the academic calendar when assessment is likely to feature will be provided within the Student Module Handbook.)

Assessment Outcome Grids (See Guidance Note)

Component 1							
Assessment Type (Footnote B.)	**Learning Outcome (1)**	**Learning Outcome (2)**	**Learning Outcome (3)**	**Learning Outcome (4)**	**Learning Outcome (5)**	**Weighting (%) of Assessment Element**	**Timetabled Contact Hours**
Unseen Open Book	✓	✓	✓	✓		65	2

Component 2							
Assessment Type (Footnote B.)	**Learning Outcome (1)**	**Learning Outcome (2)**	**Learning Outcome (3)**	**Learning Outcome (4)**	**Learning Outcome (5)**	**Weighting (%) of Assessment Element**	**Timetabled Contact Hours**
Case study					✓	35	0

Combined Total for All Components	**100%**	**2 hours**